How Does Long-Term Finance Affect Economic Volatility?[1]

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Abstract: In an approach analogous to Rajan and Zingales (1998), we examine how the ability to access long-term debt affects firm-level growth volatility. We find that firms in industries with stronger preference to use long-term finance relative to short-term finance experience lower growth volatility in countries with better-developed financial systems, as these firms may benefit from reduced refinancing risk. Institutions that facilitate the availability of credit information and contract enforcement mitigate refinancing risk and therefore growth volatility associated with short-term financing. Increased availability of long-term finance reduces growth volatility in crisis as well as non-crisis periods.

Keywords: Debt maturity; financial dependence; firm volatility; financial development

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1 Introduction

The tendency of firms to match the maturity of their assets and liabilities is well established in the literature (Hart and Moore, 1995; Demirgüç-Kunt and Maksimovic, 1999). Firms that operate in environments where the availability of long-term finance is limited due to market failures and policy weaknesses, such as weak information infrastructures, macro and political instability, poor contract enforcement, and weak investor protection, tend to be at a disadvantage when it comes to financing their long-term investments. A firm that can only use short-term debt to finance long-term assets continually needs to roll over its credit, which introduces refinancing risk as creditors may at some point refuse to roll over their financing. Refinancing risk potentially increases firm-level economic volatility, as firms that cannot refinance their investments may be forced to prematurely sell them at reduced prices possibly inducing bankruptcy.

In this paper, we examine the relationship between long-term debt finance and economic volatility using firm-level data for a set of 47 countries over the 1995-2013 period. We consider a firm-level growth volatility variable based on accounting data, and an asset return volatility variable based on stock market data. In order to deal with the identification problem that less volatile firms may be attracting more long-term finance, we relate our measures of firm-level volatility to financial and institutional development proxies in combination with an index of a firm's preference for long-term debt use, following Rajan and Zingales (1998). A firm's preference for long-term debt is captured by US firms' use of long-term debt in that industry, under the assumption that US firms are least likely to be constrained in their access to long term debt.

Our results suggest that the availability of long-term finance, be it in the form of bank loans or debt securities, reduces firm-level volatility, consistent with the notion that long-term finance mitigates refinancing risk. Refinancing risk is potentially more relevant at a time

of financial crisis when bank credit is contracting. We also examine this in our analysis by splitting the overall sample period into a pre-crisis period 1995-2006, and a crisis-and-aftermath period 2007-2013. We find that the level of banking market development is important for reducing firm-level volatility in both periods.

In further analysis, we examine how national variation in the availability of information and the quality of legal infrastructures affects the relationship between the availability of long-term credit, as proxied by financial development, and economic volatility. We find that better information, indicated by higher accounting standards, mitigates the destabilizing influence of limited access to long-term finance. This may reflect that with better information the liquidity risk of a pre-mature termination of deserving projects diminishes, as short-term creditors will be less likely to refuse to roll over their credits because they cannot accurately access the prospects of the project due to lack of information. In addition, we find that better legal infrastructures supporting credit markets reduce the economic volatility induced by a limited availability of long-term finance, perhaps because lower contract enforcement and bankruptcy costs reduce the likelihood of pre-mature liquidation.

Our evidence of a negative impact of the availability of long-term debt finance on firm volatility is robust to controlling for the overall dependence on external finance. Hence, our results suggest that changes in financial development that tend to lengthen the maturity of credit have a potentially beneficial economic effect in terms of lower economic volatility, independently of the overall availability of external finance.

A large body of papers finds that financial market development, and access to long-term financing, have positive growth effects. Among these, Rajan and Zingales (1998) find that financial market development causes higher growth of firms in industries with a greater

dependence on external finance (see also King and Levine, 1993; Levine and Zevros, 1998; Beck, Laeven, and Levine, 2000; Levine, Loayza, and Beck, 2000).[2]

Several papers find evidence that macroeconomic stability is positively related to financial market development and long-term debt use (see Beck, Demirgüç-Kunt, and Maksimovic, 2008; Demirgüç-Kunt and Maksimovic, 1999; Fan, Titman and Twite, 2012).[3] Our contribution to the literature is to examine the relationship between financial market development and economic volatility using micro, firm-level data. Our approach enables us to examine the relationship between firm-level volatility and the availability of long-term debt finance while controlling for the availability of overall external finance in some specifications.

The remainder of the paper is organized as follows. In section 2, we discuss the literature on the relationship between external finance and economic volatility. In section 3, we describe the data underlying the empirical analysis. In section 4 we present empirical results on the relationship between the availability of long-term finance and firm-level volatility. Section 5 concludes.

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[2] See Levine (2005) and Beck (2012) for detailed overviews of the literature on finance and growth. Fisman and Love (2007) provide evidence that the financial dependence variable in the analysis by Rajan and Zingales (1998) proxies for industry-varying global growth opportunities.

[3] Our paper is also related to a recent literature that examines the effects of shocks in the availability of credit on firm-level investment. Duchin, Ozbas, and Sensoy (2010) show that the impact of the recent financial crisis on corporate investment was greatest for firms with low cash reserves or high short-term debt. Almeida, Campello, Laranjeira, and Weisbenner (2011) show that firms with a larger fraction of long-term debt maturing immediately after the third quarter of 2007 reduced their investment more than firms with longer remaining maturities. See also Vermoesen, Deloof and Laveren (2013), Campello, Graham and Harvey (2010), Campello, Giambona, Graham and Harvey (2011), Chodorow-Reich (2014), and Duygan-Bump, Levkov and Montoriol-Garriga (2015).

2 The relationship between external finance and economic volatility

Theoretically, several papers address the rationale for external debt finance, and how it may affect firm volatility. Holmström and Tirole (1997), specifically, reason that financial intermediation occurs, because bankers can have a comparative advantage at screening and monitoring firms.[4] Along these lines, Diamond (1984) analyzes a model where banks have a cost advantage of monitoring, if individual savers "delegate" their monitoring to them, thereby reducing aggregate monitoring costs. Financial market development potentially reduces firm risk taking, if it increases monitoring efficacy of banks and other providers of external finance.[5]

Short-term creditors are in a relatively better position to monitor and discipline firm risk-taking, as these creditors can refuse to roll over their credits on short notice, if they conclude that the firm is not well-managed (see Rajan, 1992; Rey and Stiglitz, 1993; and Diamond and Rajan, 2001). As a consequence of more effective monitoring, external finance that is relatively short-term can reduce waste, increase efficiency and lead to lower firm volatility.

A second channel by which external debt finance may affect firm riskiness is through the moral hazard it creates regarding the firm's risk choice. Shareholders, in particular, have the incentive to choose relatively risky activities that are debt-financed, as they will benefit from strongly positive outcomes, while they can shift the risk of very negative outcomes to their creditors (Jensen and Meckling, 1976). Increased riskiness due to moral hazard may be more pronounced in case of long-term-debt, as this provides shareholders with more time to adjust the riskiness of the firm's activities.

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[4] More generally several papers argue that debt finance can be optimal in circumstances where it minimizes monitoring costs of firm activity (see Townsend, 1979; Gale and Hellwig, 1985; Boyd and Smith, 1994).

[5] In the case of banks, generous financial safety nets and implicit and explicit bailout guarantees may reduce monitoring incentives for bank liability holders and encourage aggressive risk-taking (Demirgüç-Kunt and Kane, 2002).

Through a third channel, external finance potentially increases firm riskiness, as it introduces the risk that creditors refuse to roll over their credits before a project can be profitably terminated. Diamond (1991) shows that lenders may even face incentives to liquidate viable projects. Liquidity risk is greater in the case of short-term debt as it has to be renewed relatively frequently. This can explain a preference for long-term debt on the part of firms, and increased firm volatility if long-term debt is not available when it is preferable. If long-term finance is undersupplied in a country due to reasons such as poor information or contract enforcement, firms can either reduce investment in long-term assets or bear additional liquidity risk (Aghion et al., 2010). To minimize liquidity risk as well as interest rate risk, firms often match the maturity structures of their assets and liabilities (Hart and Moore, 1995).[6] Limited access to long-term finance inhibits maturity matching when investing long-term, possibly resulting in more volatile firm growth and returns.

In summary, theoretically the relationship between long-term debt finance and firm volatility is ambiguous, as long-term debt may reduce firm-level volatility by mitigating refinancing risk, while conversely a lower ability to monitor and increased moral hazard may lead to greater risk-taking by firms.

3 The data

In this study, we relate measures of firm-level volatility to firm debt maturity structure. The sample consists of firms in all sectors with the exception of financial firms and firms in the public sector, as these firms' capital structure decisions and risk profiles are very different from other firms.

[6] For empirical evidence on asset and liability maturity matching by firms, see Schiantarelli and Sembenelli (1997), Stohs and Mauer (1996), Jaramillo and Schiantarelli (2002), and Schiantarelli and Srivastava (1997).

We use two measures of firm volatility. In particular, we construct Asset volatility (book) as the standard deviation of the growth rate of the book value of total assets over the 1995-2013 period using balance sheet information obtained from the Worldscope database (see Table A1 in Appendix A for variable descriptions and data sources). The Asset volatility (book) variable reflects investment variability over time. We exclude firms with fewer than five asset growth observations, and trim this and other firm-level variables at the 5th and 95th percentiles. This yields 24,801 Asset volatility (book) observations with a mean of 0.349, as seen in Table 1.

An alternative volatility variable, Asset volatility (stock), is calculated as the annual average of market-based annualized asset value volatility measures based on Merton's model following Anginer et al. (2014).[7] We use data from Datastream for the market value of equity and to estimate equity volatility. To ensure sufficient variability, we exclude firm-year observations with less than 90 days of nonzero stock returns. We further assume that the maturity of a firm's debt is one year, noting that the results are insensitive to this particular assumption.[8] Finally, the dividend yield is taken from Worldscope, while the risk-free return is proxied by the yield on one-year US Treasury bills. Altogether, we have 22,747 Asset volatility (stock) observations with a mean of 0.024, as reflected in Table 1.

Looking at the association between firm volatility and the maturity structure of debt can be problematic since the direction of causality can go either way, with less volatile firms being able to attract more long-term debt. We deal with this identification problem by using the approach of Rajan and Zingales (1998) to construct a measure of firms' "desired" debt

[7] See Appendix A1 of Anginer et al. (2014) for a description of Merton's method to calculate firms' asset volatility.

[8] We checked the robustness of this assumption by changing the assumed maturity of one year to the firm-specific weighted average of the maturities of short-term debt and long-term debt approximated to 0.5 and 2 years, respectively. The estimated coefficients and standard errors in the regressions of Table 2 change only slightly (unreported).

maturity structure. This index, Maturity, is given by the use of long-term finance for sectors in the US on the assumption that firms in the US are not as constrained in their choice of short-term vs. long-term external finance. Specifically, Maturity is computed as the sectoral median of the firm-level average long-term debt to total debt ratio over 1995-2013 for US firms in each three-digit Standard Industrial Classification (SIC) sector.

Variation in Maturity across sectors reflects that firm preferences for long-term finance may differ for a variety of reasons. For example, Demirgüç-Kunt and Maksimovic (1999) find that the long-term debt ratio is positively related to the ratio of fixed assets to total assets as evidence that firms try to match the maturity of their assets and liabilities. Furthermore, they find that the long-term debt ratio is negatively related to profitability as firms that are more profitable may be better off financing their investments through retained earnings. In addition, Demirgüç-Kunt and Maksimovic (1999) also find that long-term debt use is positively related to firm size as proxied by total assets which could reflect that bigger firms are less risky or that they have found better ways to limit the potential for moral hazard associated with more long-term finance. The Maturity variable has a mean of 0.764.

Analogously to Rajan and Zingales (1998), the volatility regressions include an interaction of the Maturity variable with a financial development variable that reflects the financial depth of the country where the firm is located. Five financial development variables are considered.[9] First, Private credit reflects domestic credit provided by banks to the private sector as a percentage of GDP, with a mean of 0.874. Second, Domestic credit is domestic credit provided by the financial sector (including monetary authorities, banks, and other financial corporations) as a percentage of GDP, with a mean of 1.141. Third, Capitalization is

[9] We restrict the sample to the years 1995-2013, as availability of the financial development variables before 1995 is limited. Financial development variables are for the year 1995 to reduce concerns about the endogeneity of these variables.

the sum of Domestic credit and the stock market valuation of all listed companies as a percentage of GDP. The mean of the Capitalization variable is 1.799. Fourth, Bonds is debt securities issued by all issuers as a percentage of GDP, and has a mean of 0.104. Finally, Total capitalization is the sum of Capitalization and Bonds with a mean of 1.898. Data on credit aggregates and overall stock market valuation are from the World Development Indicators database, while data for the bonds variable are from the debt securities database of the Bank of International Settlements (BIS).

As additional control variables, in some specifications we also interact the financial development proxies with a measure of firms' dependence on external finance. Analogously to Maturity, we construct the desired dependence on external finance variable, DEF, for each US sector as the share of financing of capital expenditures that cannot be covered by the operating cash flow, i.e. as (capital expenditures – operating cash flow)/capital expenditures, on the assumption that firms in the US are not constrained in their external financing. Specifically, DEF is the sectoral median of the firm-level average value of (capital expenditure - operating cashflow)/capital expenditure over the 1995-2013 period for US firms in a three-digit SIC sector.[10] In Table 1 we see that DEF has a mean of 0.100.

In addition, we examine how the relationship between the firm volatility variables and Maturity depends on several indices of institutional quality. These institutional indices measure the ease and cost of credit transactions in a certain country, and therefore might influence refinancing risk.

Accounting is a measure of accounting standards and captures the quality of information available on the firm. Such transparency may matter, as it enables debt holders to

[10] To calculate DEF, we exclude firms with fewer than ten years of observed book value of assets to ensure that we calculate this variable over a relatively extended period of capital expenditures and operating cash flows.

monitor firms better. Also, better quality information may reduce the perceived need for creditors to refuse to roll over their credits due to limited information on the firm. Accounting is an index of the disclosure standards for listed firms in a given country, compiled by the Center for International Financial Analysis and Research (CIFAR). Specifically, the Accounting variable informs on the presence, or absence, of 85 items in the annual reports of large publicly traded companies in 1993. The mean number of reported items is 72.71, as reported in Table 1.

Next, Getting credit is a measure of how easy it is to get credit as of 2006, with higher values of this variable meaning easier access to credit. The Getting credit variable reflects the existence of collateral and bankruptcy laws that facilitate lending as well as the coverage, scope and accessibility of credit information, for instance, through credit registries and credit bureaus. Greater ease of getting credit is expected to reduce a firm's liquidity risk. The Getting credit index is available from the Doing Business database of the World Bank.[11]

In addition, Contract enforcement measures the time and cost of resolving a commercial dispute through a local first-instance court in the year 2006, with higher values reflecting better enforcement. Faster and cheaper resolution of disputes is expected to facilitate lending, which should be especially important for firms that are more reliant on short-term debt financing as these firms have to refinance their debts more frequently.

Further, the Resolving insolvency index measures the time, cost and outcome of insolvency proceedings as well as the strength of the legal framework applicable to liquidation and reorganization proceedings in 2006, with higher values indicating a more efficient bankruptcy resolution. A more efficient framework for resolving insolvency is

[11] This variable is available only from 2006.

expected to reduce refinancing risk, as the suppliers of short-term credit potentially have to rely on insolvency proceedings more frequently to ensure partial or full credit repayment.

A final measure of institutional quality is the Government effectiveness index, which captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures in 1996. Higher values of this variable indicate greater government effectiveness. Government effectiveness is important for private sector efficiency. Hence, this variable is an indication of how efficiently private credit transactions can be completed. Greater government effectiveness is expected to reduce the costs and risks associated with especially short-term credit, as short-term financing implies a sequence of refinancing transactions. The Government effectiveness index is available from the World Governance Indicators database of the World Bank.

Tables A2 –A4 in Appendix A provide additional information about our sample of firms. Table A2 shows that firms are fairly evenly distributed across countries. The largest numbers of 4,225 and 2,269 firms are located in Japan and the United Kingdom, respectively, in an overall sample of 30,059 firms. Table A3 shows that firms represent a range of industries at the 2-digit SIC level, with no industry comprising more than 10% of all firms. Furthermore, Table A4 provides summary statistics of all firm-level variables separately for firms located in developing and high-income countries separately based on World Bank classification in 1995. The table shows that firms located in high-income countries have higher levels of financial development, and also better institutions as measured by the various indices used in this study.

To conclude this section, Figure 1 plots the average ratio of long-term debt to total assets over the 1995-2013 period as a proxy of long-term finance separately for firms located in developing and in high-income countries according to World Bank classification in 1995. Long-term debt use in developing countries has generally been lower than in high-income

countries, possibly reflecting greater macroeconomic instability and less developed institutional frameworks. The long-term debt to assets ratio declined in both developed and developing countries between 1995 and 2013, and it was relatively low in 2007 and 2008 in the two sets of countries at the time of the worldwide financial crisis.

4 Empirical results

4.1 Methodology

We examine the relationship between firm-level asset volatility and the availability of long-term finance as affected by a country's financial development. Our identifying assumption is that corporate preferences for long-term finance differ at the industry level globally. As a proxy for these preferences, we take the observed maturity variable at the industry level in the US. Industry-level variation in maturity in the US is assumed to be a good index of firms' preferences for longer-term finance everywhere, as US financial markets are relatively well developed. Specifically, we estimate the following model for an international sample of firms:

$$\text{Asset volatility}_{ijk} = \alpha_j + \alpha_k + \beta_0 \text{Development}_j \times \text{Maturity}_k + \epsilon_i \qquad (1)$$

where $\text{Asset volatility}_{ijk}$ is firm i's asset volatility (either Asset volatility (book) or Asset volatility (stock)), Development_j is a proxy for country j's financial development (either Private credit, Domestic credit, Capitalization, Bonds or Total Capitalization), and Maturity_k is the average maturity variable for US firms in industry k. Equation (1) includes country fixed effects, α_j, and industry fixed effects, α_k, to control for unobserved country-level and

industry-level determinants of asset volatility.[12] We report standard errors that allow for clustering at the country-industry level.

A higher level of financial development, indicated by the $Development_j$ variable, should increase the availability of external long-term finance. The interaction term $Development_j * Maturity_k$ is an index of the impact of financial development on firms' take-up of long-term finance, as greater financial development is assumed to increase long-term finance relatively more at firms in industries with greater preferences of long-term debt. The parameter β_0 measures the impact of financial development on firm asset volatility through a greater availability of long-term finance. As discussed in section 2, the impact of long-term finance on firm-level economic volatility is theoretically ambiguous, and therefore also β_0 can be either positive or negative.

A negative estimate of β_0 suggests that a greater availability of long-term debt reduces firm volatility, as it reduces the financing risks associated with short-term debt. Short-term debt is relatively risky, as short-term creditors can refuse to roll over their financing implying liquidity risk, or alternatively the cost of short-term funding can be relatively variable implying interest rate risk. Our tests do not enable us to distinguish to what extent the refinancing risks associated with short-term debt encompass liquidity risk or interest rate risk.[13] Instead, a negative estimate of β_0 suggests that there are refinancing risks generally associated with short-term debt, where the term refinancing risk refers to both liquidity and interest rate risk. Conversely, a positive estimate of β_0 would suggest that greater access to long-term debt on net increases firm volatility, as long-term debt reduces

[12] The $Development_j$ and $Maturity_k$ variables are subsumed by the country and industry fixed effects, respectively.

[13] To be able to distinguish between liquidity risk and interest rate risk, we would need data on whether firms refinance their short-term debts and at what interest rates. These data are not available.

effective risk monitoring by creditors and enhances moral hazard regarding risk choices for firms.

We also consider how variation in information availability and legal infrastructures across countries affects the relationship between firm volatility and the availability of longer-term finance as proxied by financial development. In particular, we estimate the following model:

$$\begin{aligned}\text{Asset volatility}_{ijk} &= \alpha_j + \alpha_k + \beta_0 \text{Development}_j \times \text{Maturity}_k \\ &+ \beta_1 \text{Quality}_j \times \text{Maturity}_k \\ &+ \beta_2 \text{Quality}_j \times \text{Development}_j \times \text{Maturity}_k + \epsilon_i\end{aligned} \quad (2)$$

where Quality_j is an index of country j's institutional quality (either Accounting, Getting credit, Contract enforcement, Resolving insolvency, or Government effectiveness). A negative estimated coefficient β_2 for the triple interaction term Quality_j * Develpoment_j * Maturity_k in (2) is evidence that a greater availability of long-term finance reduces firm-level asset volatility relatively much in countries with better institutions, and vice versa.

In subsection 4.2 we present the results of estimating model (1) for an international sample of firms based on data for the years 1995-2013. Subsection 4.3 provides separate estimates of (1) for the pre-crisis period 1995-2006, and for the crisis and subsequent period 2007-2013, and it examines how the relationship between firm-level volatility and the availability of long-term finance is affected by firm age and internationalization. In subsection 4.4, we provide estimates of model (2) to examine the impact of institutional quality on the relationship between firm volatility and the availability of long-term finance.

4.2 Basic results

The basic results of estimating model (1) for the variables Asset volatility (book) and Asset volatility (stock) variables are presented in Panels A and B of Table 2, respectively. Each panel contains 5 regressions that each includes an interaction term of a different financial development variable (Private credit, Domestic credit, Capitalization, Bonds, or Total capitalization) with Maturity.

In the Asset volatility (book) regression 1 of Panel A of Table 2, the estimated coefficient of the interaction term of private credit and maturity is negative at -0.0554, and it is significant at the 1% level. A greater reliance on long-term finance may lower asset growth volatility by reducing the refinancing risk associated with the need to continually roll over short-term credit. In columns 2-5, the interactions of maturity with domestic credit, capitalization, bonds, and total capitalization similarly obtain negative estimated coefficients of -0.0500, -0.0179, -0.0532 and -0.0181, respectively, that are statistically significant at least at the 10% level.

In Panel B of Table 2, we present analogous regressions where asset volatility (stock) is the dependent variable. The interaction terms in all five regressions obtain negative coefficients that are statistically significant at least at the 5% level. Overall, the results of Table 2 suggest that firms with a preference for more long-term finance, for instance on account of having more fixed assets, are able to achieve lower firm volatility in countries with better developed financial markets as greater access to long-term finance lowers refinancing risk.[14]

[14] In robustness checks we re-estimated the regressions in Table 2 for a sample that excludes the years 1995-1998 since Worldscope covers fewer firms around the beginning of our sample. The results suggest that the composition of the sample does not bias our results. In the unreported regressions, all ten estimated coefficients are negative and significant at least at the 10% level. Moreover, the magnitudes of the coefficients are similar to those in Table 2. In a further robustness test, we changed the base year for the financial development proxies

The estimated coefficients in Table 2 can be used to ascertain the impact of financial market development on the volatility of firms with different industry-level maturity variables. In particular, using the estimated coefficient of -0.0554 in regression 1 in Panel A, we see that an increase in the Private credit variable by one standard deviation (0.504 from Table 1) reduces Asset volatility (book) by 0.084(=0.0554*0.504/0.332) standard deviations more for a firm in a (hypothetical) industry with Maturity = 1 relative to a firm in an industry with Maturity = 0. More realistically, we can compare two firms in different industries with a difference in mean maturities of 2 standard deviations, or 0.250(=2*0.125) from Table 1. The one standard deviation increase in Private credit of 0.0554 then reduces Asset volatility (book) 0.021 (=0.084*0.25) standard deviations more for a firm in the high-maturity industry vs. the low-maturity industry.[15]

Our finding that financial market development reduces volatility relatively more for firms in industries with longer maturities suggests that financial development serves to reduce constraints on the availability of longer-term finance which enables firms to reduce their volatility. The estimation of Table 2, however, does not inform on the overall volatility effect of financial market development for any particular firm, say the firm with average maturity. This effect for any one firm cannot be inferred from the regression output in Table 2, as the financial development variable itself is subsumed in the country fixed effects, and hence is not estimated. We include these country fixed effects in the regressions, as we wish to control for any relevant, but not included country characteristics (beyond financial

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from 1995 to 2000, and then re-estimated all regressions of Table 2 based on data for the period of 2000-2013. The unreported results can be summarized as follows. In nine of the ten regressions we obtain negative coefficients for the interactions between maturity and the included financial development proxy that in eight cases are significant at the 5% level. These coefficients have similar magnitudes to those reported in Table 2. In one case we obtain a positive, insignificant coefficient.

[15] An analogous calculation based on the estimated coefficient of -0.00274 in regression 1 of Panel B yields that a one standard deviation increase in Private credit of 0.0554 reduces Asset volatility (stock) by 0.030 standard deviations more for a firm in the high-maturity industry vs. the low-maturity industry.

development) while estimating the differential impact of financial development on firms in high-maturity vs. low-maturity industries.

Naturally, the overall effect of financial development (not just coming through its interaction with maturity) on firm volatility is of interest. Therefore, we re-estimate the regressions of Table 2 without the country fixed effects so that the financial development variables can be included in the estimation. The resulting table is reported in Appendix B. These additional results, as discussed in the appendix, suggest that financial development per se reduces firm volatility, especially for firms in industries with longer maturities.

Financial development is likely to differentially affect firms with a greater dependence on long-term finance as well as firms with a greater dependence on external financial generally. To check whether long-term external finance has an impact on firm risk independently of overall external finance, we next re-estimate the regressions in Table 2, while adding an interaction of the included financial development variable with DEF, proxying for the dependence on overall external finance, as an additional control variable. The results are reported in Table 3.

In the Asset volatility (book) regression 1 of panel A of Table 3, the interaction of private credit with maturity obtains a negative coefficient of -0.0579 that is significant at the 1% level, while the interaction of private credit with DEF obtains a positive and insignificant coefficient. These results suggest that financial deepening reduces firm volatility through a lengthening of external debt maturity, rather than through a greater availability of external finance more generally. In regressions 2 to 5, the included interactions of a financial development proxy with maturity similarly obtain negative coefficients that are significant, except for the interaction of bonds with maturity in column 4. The interactions involving DEF are positive and insignificant, except for regression 5, where the interaction of total capitalization with DEF obtains a positive coefficient that is significant at 10%. The latter

result suggests that financial deepening leads to higher firm risk insofar as it increases the availability of external finance generally. Additional external finance may increase firm risk, as it accentuates moral hazard regarding the firm's risk choices and as it increases refinancing risk.

Similar results obtain in panel B of Table 3, in which asset volatility (book) is replaced by asset volatility (stock) as dependent variable. The included interactions of a financial development variable with maturity obtain negative and significant coefficients in all five regressions, while the interactions of the financial development variable with DEF are estimated with positive and significant coefficients in regressions 1, 4 and 5.

Overall, the results of Table 3 suggest that a greater availability of long-term external finance reduces firm volatility even if we control for the availability of external finance generally. As a main potential explanation, long-term finance may reduce firm risk as it mitigates refinancing risk. In contrast, there is some evidence that greater availability of external finance appears to lead to higher firm risk. This could reflect that use of overall external finance enhances firms' risk-shifting incentives and augments refinancing risks.

4.3 The crisis period, and heterogeneity in firm age and internationalization

In this subsection, we examine whether the relationships between financial development and firm volatility were different following the recent economic and financial crisis. In addition, we consider whether these relationships are different depending on firm-level age and internationalization.

The impact of long-term debt finance on firm stability can be expected to be especially pronounced during and immediately after a financial crisis. Specifically, negative asset growth and asset valuation outcomes associated with prior risk choices on the part of the firm, and also refinancing problems, are more likely to materialize during an economic and financial crisis. To investigate this, we split the sample into a pre-crisis period 1995-

2006, and a crisis period and its aftermath 2007-2013. Specifically, we calculate our firm volatility measures separately for these two periods, and then re-estimate the regressions of Table 2 for the two subsamples. The results for the pre-crisis period, and the crisis period and its aftermath are reported in Tables 4 and 5, respectively.

In Panel A of Table 4 with pre-crisis regressions, asset volatility (book) is negatively and significantly related to the interactions of maturity with private credit and domestic credit, respectively. This suggests that long-term finance had a mitigating impact on firm risk also in the pre-crisis period. In the other three regressions of Panel A, however, the included interactions of a financial development variable with maturity are not estimated to be significant.

Panel B also shows some, but a limited impact of the availability of long-term finance on firm volatility in the pre-crisis period. In particular, the interaction of domestic credit with maturity obtains a negative and significant coefficient in column 2, while all other interaction terms are estimated to be insignificant.

In Panel A of Table 5 for the years 2007-2013, we see that asset volatility (book) is negatively related to the included interaction terms in all five regressions, and that the estimated coefficients are statistically significant in all cases except for the interaction of bonds with maturity in column 4. In Panel B with asset volatility (stock) regressions, a similar picture emerges, as the estimated coefficients for the included interaction terms are all negative, and statistically significant. Overall, the results of Table 6 show a clear negative relationship between reliance on long-term debt and firm volatility during the crisis and its aftermath.

Comparing the results of Tables 4 and 5, we see that the interaction of bonds with maturity is significant in Panel B of Table 5 but in neither of the panels of Table 4. This could mean that the availability of bond finance only has a positive impact on firm stability

during a crisis period, since the alternative, long-term bank finance, tends to be more limited during these periods. This is consistent with evidence in Adrian, Colla, and Shin (2012), and Becker and Ivashina (2014) that although bank loans decline during a financial crisis, bond financing actually increases to make up part of the gap. For other variables, across Tables 5 and 6 significantly estimated coefficients of similar magnitude arise in several instances. For example, the estimated coefficient for the interaction of private credit with maturity is -0.0348 in regression 1 of Panel A of Table 4 and significant at 10%, while it is -0.0338 in the corresponding regression in Table 5 and significant at 5%. In this case, it appears that the expected impact of the availability of long-term finance on firm volatility is similar in pre-crisis and crisis periods, even though the impact of long-term finance on firm volatility may be more difficult to estimate during the more tranquil pre-crisis period.[16]

Next, we examine how the relationship between firm-level asset volatility and the availability of long term finance varies with firm age. The negative estimated relationships between asset volatility and the availability of long-term finance in Table 2 could possibly reflect that older firms use more long-term finance, as they have easier access to this type of finance, while at the same time they have less volatile assets. To control for firm age, we split the overall sample into two subsamples containing firms in sectors in which the average firm age in the US is below and above the median firm age, respectively. We then re-estimate the regressions of Table 2 separately for the two subsamples.

Table 6 shows results for the subsample of firms in industries with younger firms. Estimated coefficients in both Panels A and B are negative in all regressions. In addition, they are statistically significant throughout with the exception of the regressions that include

[16] We tested if survivorship bias drives our results, but found no indication of this. In particular, we re-estimated all regressions in Tables 4 and 5 for the sample of firms that were active in both the 1995-2006, and 2007-2013 periods. We found qualitatively and quantitatively similar results to those reported.

the interaction Bonds * Maturity. Table 7 shows analogous results for the subsample of firms in industries with older firms. Estimated coefficients in all regressions are negative except in the Asset volatility (stock) regression 3 in Panel B that includes the interaction Capitalization * Maturity. In addition, estimated coefficients are significant in the Asset volatility (book) regressions 1 and 2, including the Private credit * Maturity and Domestic credit * Maturity interactions, and in the Asset volatility (stock) regressions 2 and 4 that include the Domestic credit * Maturity and Bonds * Maturity interaction.

The overall negative and significant estimated coefficients in both Tables 6 and 7 suggest that the negative relationships between asset volatility and the availability of long term finance found in Table 2 cannot be attributed to the distinction between younger and older firms. A comparison of Tables 6 and 7 further shows that estimated coefficients in Table 6 for the sample of younger firms are more negative than in Table 7 for the sample of older firms. Hence, financial market development reduces the volatility of older firms in industries that tend to rely more on long-term finance in the US relatively little. Potential explanations for this are that older firms may have easier access to long-term finance even in countries with lower levels of financial development on account of their established reputations, or perhaps that they can more easily substitute retained earnings for external long-term finance.

To conclude this subsection, we consider the implications of firm internationalization for the relationship between the availability of long-term finance, as proxied by financial development, and firm asset volatility. Firms that are part of multinational corporations could on average have more long-term finance as they can benefit from an internal capital market within the firm, while at the same time they could display less asset volatility if being part of a multinational firm reduces the variability in the book and market valuation of assets. To control for this possible source of endogeneity, we split the overall sample into two

subsamples based on whether firms are in industries where US firms on average have a foreign assets to total assets ratio below and above the median, respectively. For both subsamples we find results that are qualitatively and quantitatively similar to the results in Table 2, which are not reported. These findings suggest that the results reported in Table 2 cannot be attributed to the distinction between low-internationalization and high-internationalization firms.[17]

4.4 The role of institutional quality

In this section, we present the results of estimating model (2) to determine how information and legal infrastructures affect the relationship between the availability of long-term finance and firm-level volatility. To start, as a proxy for the availability of information we employ accounting standards. Greater transparency increases creditors' ability to monitor the firm, and hence is expected to reduce the firm's ability to engage in risk-shifting. This suggests that higher accounting standards should attenuate the tendency of external financing to increase firm volatility (as evident from Table 3). In addition, more transparency may reduce refinancing risk, as it should reduce the probability that creditors refuse to roll over their credits for lack of reliable data on the firm.

The beneficial effects of greater transparency in reducing the tendency of external finance to contribute to firm volatility should be especially pronounced in the case of short-term debt, as more transparency particularly strengthens the ability of short-term creditors to monitor and discipline the firm's risk-taking. Also, short-term credit needs to be continually rolled over, and hence good information is particularly important in the case of short-term

[17] As an additional robustness tests, we re-estimated the regressions of Table 2 for the sample of listed firms, and we estimated weighted regressions analogous to those of Table 2 using weights calculated as the inverse of the number of firms in a country-industry over the total number of firms. Both sets of regressions yield results that are qualitatively and quantitatively similar to those in Table 2 (unreported). Finally, we considered whether variation in government ownership might drive our results. This is unlikely to be the case, since only about 0.5% of the firms in our sample are categorized by Worldscope as having majority government ownership.

credit in preventing credit-worthy projects from not being refinanced because of poor quality information. For these reasons, with higher accounting standards we expect an increase in firm debt maturity to be associated with a relatively smaller reduction in volatility.

Table 8 shows regressions that investigate the role of accounting standards in affecting the relationship between access to long-term debt finance and firm volatility. Specifically, taking the specifications in Table 2, these regressions include triple interaction terms of a financial market development variable, Maturity, and Accounting.

In Panel A of Table 8, the dependent variable is asset volatility (book). In all five regressions, the included triple interaction terms obtain positive coefficients that are significant in regressions 1, 3, 4 and 5. In these four regressions, the double interaction terms of the included financial development variable and maturity obtain negative and significant coefficients. In the asset volatility (stock) regressions of panel B, we find that the triple interaction of bonds, maturity and accounting receives a positive and significant coefficient in regression 4, while the double interaction of bonds and maturity loads with a negative and significant coefficient in this regression. These results support the hypothesis that shorter maturity tends to increase firm volatility less in environments with better information, since with better information, pre-mature liquidation of deserving projects happens less frequently and the use of short-term debt increases liquidity risk less.

Next, in Table 9 we consider the role of the Getting credit variable, as an index of legal infrastructure that facilitates getting credit and of the existence of credit registries and credit bureaus. In the asset volatility (book) regressions of Panel A, the triple interactions of a financial market variable, Maturity and Getting credit receive positive coefficients that are statistically significant in regressions 3-5. The double interactions of Maturity and Getting credit obtain negative and significant coefficients in these regressions. These results suggest that with easier access to credit financial market development – implying greater availability

of long-term debt - reduces asset growth volatility relatively less for firms with a preference for long-term debt. This implies that firms' refinancing risks that are being alleviated by a greater availability of long-term debt are lower in case they have easier access to credit.[18]

In the asset volatility (stock) regressions Panel B of Table 9, triple interactions involving Getting credit obtain positive and significant coefficients, while the corresponding double interactions receive negative and significant coefficients. This is further evidence that the ability of get credit easily reduces the negative volatility consequences of a lack of financial market development and long-term finance.

Next, in Table 10 we consider regressions that include the Contract enforcement variable, which is an index of the time and cost of resolving a commercial dispute through a first-instance court. In the asset volatility (book) regressions of Panel A, the triple interactions of a financial development variable, Maturity, and Contract enforcement are estimated with insignificant coefficients. In the asset volatility (stock) regressions in Panel B, these triple interactions instead receive positive coefficients that are statistically significant, while the corresponding double interactions are estimated with negative and significant coefficients. Easier contract enforcement thus appears to reduce the volatility benefits of financial development that facilitates long-term credit, as easier contract enforcement reduces volatility especially for firms with a preference for short-term credit. This may reflect that short-term creditors may be more patient and more likely to refinance their credits in countries with more efficient contract enforcement, which reduces the refinancing risk associated with short-term financing.

[18] The Getting credit variable particularly addresses the ease of access to credit. Hence, these results suggest that the refinancing risks that are being alleviated by a greater availability of long-term debt at least in part reflect a lower liquidity risk, i.e. risk related to the quantity of the refinancing rather than its price.

The regressions of Table 11 include triple and double interaction terms of the Resolving insolvency variable which measures the time, cost, and outcome of insolvency proceedings. The triple interactions are estimated with insignificant coefficients in the asset volatility (book) regressions of Panel A, while they receive positive and significant coefficients in asset volatility (stock) regressions 3 and 5 of Panel B. This provides some evidence that more efficient bankruptcy resolution reduces the refinancing risks of short-term debt.

Finally, we consider the Government effectiveness variable as an overall measure of the effectiveness of public policies and governance, with the results reported in Table 12. In the asset volatility (book) regression 4 in Panel A, the interaction of Bonds with Maturity and Government effectiveness obtains a positive and significant coefficient, while the double interaction Bonds * Maturity obtains a negative and significant coefficient in this regression. In panel B, we obtain positive and significant coefficients for the triple interactions of Private credit, Capitalization and Total capitalization with Maturity and Government effectiveness in asset volatility (book) regressions 1, 3 and 5, while the corresponding double interactions obtain negative and significant coefficients. These results suggest that more effective government policies reduce the negative impact of short-term debt on firm volatility, again potentially reflecting the greater patience of short-term creditors in dealing with debtors when they are more confident that their rights are protected in a better institutional environment. The reduced likelihood of pre-mature liquidation decreases the refinancing risk associated with short-term financing.

Overall, the results of this section suggest that the negative volatility consequences of a lack of financial development implying reduced access to long-term finance are attenuated in countries with high-quality information and legal infrastructures as these reduce the potential for short-term credit to add to firm-level volatility.

5 Conclusions

In this paper, we examine the relationship between access to long-term debt finance and economic volatility at the firm level. Using an approach similar to Rajan and Zingales (1998), we find that for firms with a greater demand for long-term debt, a greater availability of long-term debt finance, as proxied by different measures of financial development, reduces firm volatility. This could reflect that a greater availability of long-term finance mitigates the refinancing risks associated with the requirement to continually roll over short-term credit.

Investigating the period before and after the global financial crisis separately, we see that the negative impact of the availability of long-term bank finance on firm volatility holds for the full sample of 1995-2013. However, when we proxy financial development by bond market development, we see that the contribution of bond market development to reducing firm volatility is only found in the later period, perhaps because bond finance can be substituted to make up for the reduction in long-term bank finance during crisis periods.

Further, we show that adequate information availability and a high-quality contracting environment supporting credit markets reduce the negative implication for firm volatility of limited access to long-term debt, as these factors mitigate the refinancing risks associated with short-term debt. In particular, the refinancing risks associated with short-term finance appear to be lower if accounting standards are high, if legal institutions support access to credit, contract enforcement and efficient insolvency resolution, and if the government operates effectively.

Our evidence of a negative relationship between the availability of long-term debt finance on firm volatility is robust to controlling for overall dependence on external finance. Hence, our results suggest that changes in financial development that lengthen the maturity of

credit have a potentially beneficial economic effect in terms of lower economic volatility, independently of the overall availability of external finance. For this reason, countries with limited availability of long-term debt finance resulting from market failures and policy weaknesses can benefit from policies that could increase its supply. Promoting macroeconomic and political stability, improving the information infrastructure, strengthening legal institutions including investor protection, and creating a contestable banking system that is adequately supervised and regulated may be effective policies in this regard.

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Appendix A. Data description

Table A1: Variable descriptions and data sources

Variable	Description	Source
Asset volatility (book)	Standard deviation of the growth rate of the book value of total assets.	Worldscope
Asset volatility (stock)	Volatility of the value of a firm's assets calculated based on Merton's model, averaged over time.	Worldscope, Datastream
Maturity	Median of the average value over 1995-2013 of the ratio of long-term debt to total debt for US firms in a three-digit sector in the Standard Industrial Classification system.	Worldscope
DEF	Median of the average value over 1995-2013 of (capital expenditure - operating cashflow)/capital expenditure for US firms in a three-digit sector in the Standard Industrial Classification system.	Worldscope
Private credit	Domestic credit to the private sector by banks (% of GDP) as of year-end 1995. Domestic credit to the private sector by banks refers to financial resources provided to the private sector by deposit taking corporations except central banks, such as through loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment. For some countries these claims include credit to public enterprises.	WDI
Domestic credit	Domestic credit provided by the financial sector (% of GDP) as of year-end 1995. Domestic credit provided by the financial sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The financial sector includes monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits).	WDI
Capitalization	Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995.	WDI
Bonds	Debt securities issued by all issuers (% of GDP) as of year-end 1995.	BIS, WDI
Total capitalization	Sum of Capitalization and Bonds.	BIS, WDI
Accounting	Index of accounting standards in 1993. Higher values indicate more disclosure in firms' annual reports.	CIFAR
Getting credit	Index of the legal rights of borrowers and lenders that facilitate lending and a better availability of credit information in 2006 Higher values indicate easier access to credit.	Doing Business
Contract enforcement	Index measuring the time and cost of resolving a commercial dispute through a local first-instance court in 2006. Higher values indicate easier contract enforcement.	Doing Business
Resolving insolvency	Index measuring the time, cost and outcome of insolvency proceedings involving domestic entities as well as the strength of the legal framework applicable to liquidation and reorganization proceedings in 2006. Higher values indicate more efficient bankruptcy resolution.	Doing Business

Government effectiveness	Index capturing perceptions of th quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies in 1996. Higher values indicate more effective government policies.	World Governance Indicators

Table A2: Number of firms by country

The table shows the number of firms in the sample by country. Countries are group into developing and high-income countries based on World Bank classification in 1995. Developing countries include low-income and middle-income countries.

High-income country	Number of firms	Developing country	Number of firms
Australia	1,557	Argentina	108
Austria	125	Brazil	474
Belgium	157	Chile	192
Bermuda	46	China	3,084
Canada	1,637	Colombia	60
Denmark	192	Czech Republic	57
Finland	177	Greece	339
France	1,094	Hungary	54
Germany	1,025	India	2,270
Hong Kong	1,043	Indonesia	374
Ireland	98	Malaysia	1,052
Israel	421	Mexico	204
Italy	346	Pakistan	206
Japan	4,225	Peru	109
Korea, Republic of	1,874	Philippines	171
Liechtenstein	1	Poland	440
Luxembourg	51	Russian Federation	591
Netherlands	296	South Africa	470
New Zealand	143	Sri Lanka	162
Norway	299	Thailand	523
Portugal	92	Turkey	279
Singapore	706		
Spain	177		
Sweden	528		
Switzerland	261		
United Kingdom	2,269		
Total high-income countries	18,840	Total developing countries	11,219
		Total	30,059

Table A3: Number of firms by industry

The table shows the number of firms in each 2-digit SIC sector in the sample.

Industry code	Name of sector	Number of firms
1	Agricultural Production - Crops	179
2	Agricultural Production - Livestock and Animal Specialties	84
7	Agricultural Services	44
8	Forestry	31
10	Metal Mining	968
12	Coal Mining	180
13	Oil and Gas Extraction	953
14	Mining and Quarrying of Nonmetallic Minerals, Except Fuels	50
15	Construction - General Contractors & Operative Builders	955
16	Heavy Construction, Except Building Construction, Contractor	514
17	Construction - Special Trade Contractors	141
20	Food and Kindred Products	1,481
21	Tobacco Products	37
22	Textile Mill Products	563
23	Apparel, Finished Products from Fabrics & Similar Materials	341
24	Lumber and Wood Products, Except Furniture	195
25	Furniture and Fixtures	155
26	Paper and Allied Products	463
27	Printing, Publishing and Allied Industries	421
28	Chemicals and Allied Products	2,207
29	Petroleum Refining and Related Industries	176
30	Rubber and Miscellaneous Plastic Products	418
31	Leather and Leather Products	102
32	Stone, Clay, Glass, and Concrete Products	640
33	Primary Metal Industries	1,026
34	Fabricated Metal Products	685
35	Industrial and Commercial Machinery and Computer Equipment	1,665
36	Electronic & Other Electrical Equipment & Components	2,100
37	Transportation Equipment	855
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks	789
39	Miscellaneous Manufacturing Industries	243
40	Railroad Transportation	44
41	Local & Suburban Transit & Interurban Highway Transportation	54
42	Motor Freight Transportation	211
44	Water Transportation	385
45	Transportation by Air	206
46	Pipelines, Except Natural Gas	9

47	Transportation Services	162
48	Communications	822
49	Electric, Gas and Sanitary Services	946
50	Wholesale Trade - Durable Goods	1,014
51	Wholesale Trade - Nondurable Goods	646
52	Building Materials, Hardware, Garden Supplies & Mobile Homes	48
53	General Merchandise Stores	236
54	Food Stores	224
55	Automotive Dealers and Gasoline Service Stations	127
56	Apparel and Accessory Stores	222
57	Home Furniture, Furnishings and Equipment Stores	193
58	Eating and Drinking Places	306
59	Miscellaneous Retail	357
70	Hotels, Rooming Houses, Camps, and Other Lodging Places	366
72	Personal Services	62
73	Business Services	2,927
75	Automotive Repair, Services and Parking	54
76	Miscellaneous Repair Services	18
78	Motion Pictures	220
79	Amusement and Recreation Services	278
80	Health Services	215
81	Legal Services	2
82	Educational Services	118
83	Social Services	27
84	Museums, Art Galleries and Botanical and Zoological Gardens	1
87	Engineering, Accounting, Research, and Management Services	792
89	Services, Not Elsewhere Classified	106
	Total	30,059

Table A4: Summary statistics by country income status

The table shows summary statistics separately for firms residing in developing and high-income countries based on World Bank classification in 1995. Developing countries include low-income and middle-income countries. Asset volatility (book) is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. Asset volatility (stock) is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. DEF is the sectoral median of the average firm level value of (capex - operating cashflow)/capex in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Accounting is an index of accounting standards in 1993, with higher values indicating more disclosure. Getting credit is an index of the legal rights of borrowers and lenders that facilitate lending and a better availability of credit information in 2006, with higher values indicating easier access to credit. Contract enforcement is an index measuring the time and cost of resolving a commercial dispute through a local first-instance court in 2006, with higher values reflecting better enforcement. Resolving insolvency is an index measuring the time, cost and outcome of insolvency proceedings involving domestic entities as well as the strength of the legal framework applicable to liquidation and reorganization proceedings in 2006, with higher values indicating more efficient bankruptcy resolution. Government effectiveness is an index capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures in 1996, with higher values indicating more effective government policies.

	Developing countries			High-income coutries		
Variable	Obs	Mean	SD	Obs	Mean	SD
Asset volatility (book)	9,484	0.35	0.309	15,317	0.349	0.346
Asset volatility (stock)	8,841	0.0236	0.00941	13,906	0.0249	0.0124
Maturity	11,219	0.778	0.124	18,840	0.756	0.124
DEF	10,232	0.0444	1.428	17,968	0.132	1.382
Private credit	11,219	0.58	0.392	18,793	1.049	0.481
Domestic credit	11,219	0.724	0.362	18,793	1.391	0.823
Capitalization	11,219	1.237	1.021	18,793	2.134	0.989
Bonds	11,219	0.0367	0.0447	18,840	0.145	0.201
Total capitalization	11,219	1.274	1.032	18,793	2.271	0.97
Accounting	6,510	66.77	8.237	18,742	74.77	5.963
Getting credit	11,219	42.99	22.5	18,742	78.2	13.8
Contract enforcement	11,219	56.43	17.94	18,742	72.48	8.995
Resolving insolvency	11,219	32.98	12.56	18,742	88.02	13.57
Government effectiveness	11,219	0.057	0.459	18,840	1.433	0.482

Appendix B. Estimating the effect of financial development on firm volatility

The regressions of Table 2 include country fixed effects to be able to identify a differential impact of the financial development variables on the volatility of firms in high-maturity vs. low-maturity industries. The inclusion of country fixed effects enables us to control for any country-level determinants of firm-level volatility (beyond financial development) in the estimation. In Table B1 of this appendix, we report the results of re-estimating the regressions of Table 2 without country fixed effects so that the financial development variables can be included in the estimation. The estimated coefficients in these regressions can be used to calculate an estimated impact of financial development on firm volatility.

In the regressions of Panel A, asset volatility (book) is the dependent variable. The financial development proxies Private credit, Domestic credit, Capitalization and Total capitalization obtain negative and significant coefficients, while their interactions with Maturity are insignificant. From regression 1, we can calculate that a one standard deviation increase in Private credit is associated with a -0.057 (= -0.113 * 0.504) reduction in asset volatility, or about one fifth of its standard deviation.

In the regressions of Panel B, asset volatility (stock) is the dependent variable. In these regressions, all five interactions of the various financial development proxies with Maturity obtain negative and significant coefficients, which is consistent with the results of Panel B of Table 2. The magnitudes of these coefficients are larger in absolute value than the corresponding coefficients in Panel B of Table 2, which suggests that country-level factors other than financial development could simultaneously explain reliance on long-term finance and firm volatility. Further, the financial development proxies obtain positive coefficients, which are significant in regressions 3 to 5 (for Capitalization, Bonds and Total capitalization). These results together imply that financial development tends to lower firm

volatility relatively more for firms that rely on longer term finance. The estimated coefficients in Panel B allow us to compute the estimated impact of financial development on the volatility of a firm with any maturity. For instance, for a firm in an industry with average maturity (0.764 as seen in Table 1), a one standard deviation increase in Total capitalization (1.104 from Table 1) is associated with a -0.00056 (= -0.00263 * 0.764 * 1.104 + 0.0015 * 1.104) reduction in firm asset volatility (about 2 percent of its standard deviation). Overall, the results of Table B1 suggest that financial development per se reduces firm volatility.

Table B1: Firm volatility and use of long-term finance – estimating the effect of financial development

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Country and industry fixed effects are included. Sample includes all firms except financial firms and firms in the public sector. Industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	0.0383				
	(0.60)				
Private credit	-0.113**				
	(-2.12)				
Domestic credit * Maturity		0.00525			
		(0.16)			
Domestic credit		-0.0769***			
		(-2.78)			
Capitalization * Maturity			0.0383		
			(1.28)		
Capitalization			-0.0687***		
			(-2.78)		
Bonds * Maturity				-0.154	
				(-0.77)	
Bonds				0.218	
				(1.32)	
Total capitalization * Maturity					0.0391
					(1.28)
Total capitalization					-0.0667***
					(-2.64)
Constant	0.604***	0.616***	0.602***	0.531***	0.605***
	(11.63)	(11.79)	(11.58)	(10.93)	(11.45)
Observations	24763	24763	24763	24801	24763
Adjusted R-squared	0.097	0.107	0.098	0.084	0.096

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00406*				
	(-1.93)				
Private credit	0.000980				
	(0.58)				
Domestic credit * Maturity		-0.00354***			
		(-2.93)			
Domestic credit		0.000851			
		(0.89)			
Capitalization * Maturity			-0.00252***		
			(-2.63)		
Capitalization			0.00136*		
			(1.76)		
Bonds * Maturity				-0.0217***	
				(-3.04)	
Bonds				0.0196***	
				(3.31)	
Total capitalization * Maturity					-0.00263***
					(-2.74)
Total capitalization					0.00150*
					(1.94)
Constant	0.0349***	0.0353***	0.0344***	0.0329***	0.0345***
	(17.46)	(18.48)	(17.32)	(16.55)	(17.40)
Observations	22713	22713	22713	22747	22713
Adjusted R-squared	0.202	0.209	0.197	0.196	0.197

Figure 1: Ratio of average long-term debt to assets of firms in developing and high-income countries

The graph shows the average ratio of long-term debt to total assets for firms located in developing and high-income countries based on World Bank classification in 1995. Developing countries include low-income and middle-income countries. LTD/TA is the ratio of long-term debt to total assets. Sample is restricted to firms with data throughout the 1995-2013 period.

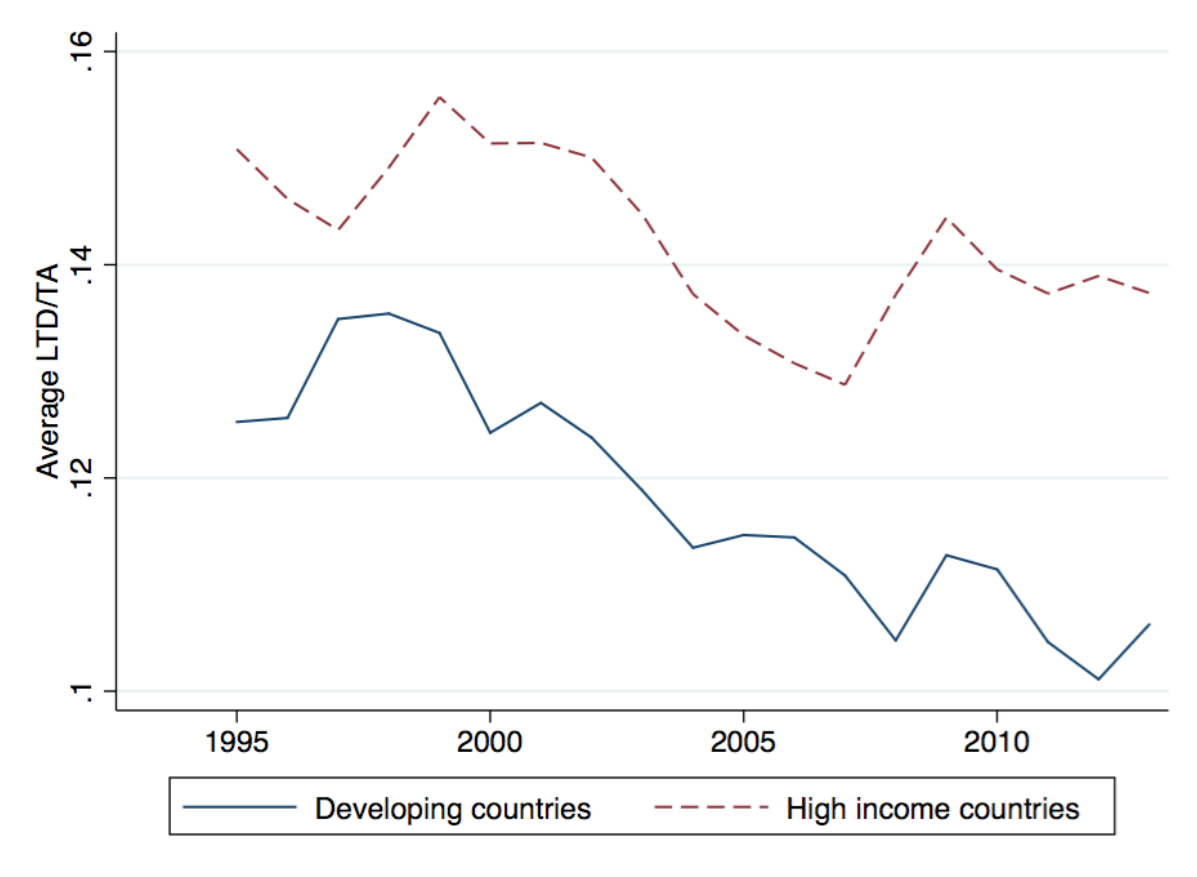

Table 1: Descriptive statistics

Asset volatility (book) is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. Asset volatility (stock) is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. DEF is the sectoral median of the average firm level value of (capex - operating cashflow)/capex in the US over the period 1995-2013. Accounting is an index of accounting standards in 1993, with higher values indicating more disclosure. Getting credit is an index of the legal rights of borrowers and lenders that facilitate lending and a better availability of credit information in 2006, with higher values indicating easier access to credit. Contract enforcement is an index measuring the time and cost of resolving a commercial dispute through a local first-instance court in 2006, with higher values reflecting better enforcement. Resolving insolvency is an index measuring the time, cost and outcome of insolvency proceedings involving domestic entities as well as the strength of the legal framework applicable to liquidation and reorganization proceedings in 2006, with higher values indicating more efficient bankruptcy resolution. Government effectiveness is an index capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures in 1996, with higher values indicating more effective government policies. Sample excludes US firms.

Variable	Obs	Mean	SD	Min	Max
Asset volatility (book)	24,801	0.349	0.332	0.0624	1.965
Asset volatility (stock)	22,747	0.0244	0.0114	0.00850	0.0648
Maturity	30,059	0.764	0.125	0.0208	0.993
Private credit	30,012	0.874	0.504	0.0937	1.788
Domestic credit	30,012	1.141	0.760	0.129	2.834
Capitalization	30,012	1.799	1.091	0.295	3.774
Bonds	30,059	0.104	0.170	0	3.176
Total capitalization	30,012	1.898	1.104	0.298	3.856
DEF	28,200	0.100	1.400	-3.089	7.863
Accounting	25,252	72.71	7.491	56	85
Getting credit	29,961	65.02	24.48	18.75	100
Contract enforcement	29,961	66.47	15.21	25.81	93.36
Resolving insolvency	29,961	67.41	29.73	0.480	99.71
Government effectiveness	30,059	0.919	0.817	-0.588	2.101

Table 2: Firm volatility and use of long-term finance

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	-0.0554***				
	(-2.76)				
Domestic credit * Maturity		-0.0500***			
		(-3.21)			
Capitalization * Maturity			-0.0179**		
			(-2.00)		
Bonds * Maturity				-0.0532*	
				(-1.85)	
Total capitalization * Maturity					-0.0181**
					(-2.06)
Observations	24763	24763	24763	24801	24763
Adjusted R-squared	0.141	0.141	0.140	0.140	0.140

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00274**				
	(-2.52)				
Domestic credit * Maturity		-0.00304***			
		(-4.02)			
Capitalization * Maturity			-0.00102**		
			(-2.26)		
Bonds * Maturity				-0.00401**	
				(-2.28)	
Total capitalization * Maturity					-0.00111**
					(-2.48)
Observations	22713	22713	22713	22747	22713
Adjusted R-squared	0.269	0.270	0.269	0.269	0.269

Table 3: Controlling for dependence on external finance

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. DEF is the sectoral median of the average firm level value of (capex - operating cashflow)/capex in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	-0.0579***				
	(-2.70)				
Private credit * DEF	0.00664				
	(1.18)				
Domestic credit * Maturity		-0.0491***			
		(-2.91)			
Domestic credit * DEF		0.00424			
		(1.08)			
Capitalization * Maturity			-0.0188**		
			(-2.01)		
Capitalization * DEF			0.00406		
			(1.51)		
Bonds * Maturity				-0.0318	
				(-1.02)	
Bonds * DEF				0.0454	
				(1.45)	
Total capitalization * Maturity					-0.0184**
					(-1.99)
Total capitalization * DEF					0.00504*
					(1.80)
Observations	23196	23196	23196	23234	23196
Adjusted R-squared	0.141	0.141	0.141	0.141	0.141

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00257**				
	(-2.21)				
Private credit * DEF	0.000302*				
	(1.74)				
Domestic credit * Maturity		-0.00299***			
		(-3.73)			
Domestic credit * DEF		0.000191			
		(1.50)			
Capitalization * Maturity			-0.000981**		
			(-2.03)		
Capitalization * DEF			0.000108		
			(1.29)		
Bonds * Maturity				-0.00422***	
				(-2.73)	
Bonds * DEF				0.00376***	
				(4.99)	
Total capitalization * Maturity					-0.00105**
					(-2.21)
Total capitalization * DEF					0.000152*
					(1.83)
Observations	21403	21403	21403	21436	21403
Adjusted R-squared	0.267	0.268	0.267	0.270	0.267

Table 4: Firm volatility and use of long-term finance before 2007

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2006. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2006. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	-0.0348*				
	(-1.89)				
Domestic credit * Maturity		-0.0282**			
		(-2.16)			
Capitalization * Maturity			0.000383		
			(0.05)		
Bonds * Maturity				0.0209	
				(0.62)	
Total capitalization * Maturity					0.00146
					(0.18)
Observations	15103	15103	15103	15121	15103
Adjusted R-squared	0.152	0.152	0.152	0.152	0.152

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00132				
	(-1.07)				
Domestic credit * Maturity		-0.00191**			
		(-2.24)			
Capitalization * Maturity			-0.000305		
			(-0.57)		
Bonds * Maturity				-0.00307	
				(-1.57)	
Total capitalization * Maturity					-0.000389
					(-0.74)
Observations	16824	16824	16824	16845	16824
Adjusted R-squared	0.262	0.262	0.261	0.262	0.262

Table 5: Firm volatility and use of long-term finance between 2007 and 2013

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 2007-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 2007-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	-0.0338**				
	(-2.46)				
Domestic credit * Maturity		-0.0337***			
		(-3.64)			
Capitalization * Maturity			-0.0179***		
			(-2.88)		
Bonds * Maturity				-0.0325	
				(-0.91)	
Total capitalization * Maturity					-0.0172***
					(-2.77)
Observations	18833	18833	18833	18858	18833
Adjusted R-squared	0.143	0.143	0.143	0.142	0.143

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00422***				
	(-3.51)				
Domestic credit * Maturity		-0.00361***			
		(-4.09)			
Capitalization * Maturity			-0.00168***		
			(-3.30)		
Bonds * Maturity				-0.00404*	
				(-1.76)	
Total capitalization * Maturity					-0.00167***
					(-3.37)
Observations	17997	17997	17997	18024	17997
Adjusted R-squared	0.253	0.254	0.253	0.252	0.253

Table 6: Firm volatility, the use of long-term finance and firm age: young firms

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. The sample excludes financial firms and firms in the public sector, as well as sectors where the average age of US firms is above the median firm age. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	-0.0712**				
	(-2.28)				
Domestic credit * Maturity		-0.0606**			
		(-2.56)			
Capitalization * Maturity			-0.0423***		
			(-3.01)		
Bonds * Maturity				-0.0344	
				(-0.65)	
Total capitalization * Maturity					-0.0412***
					(-2.94)
Observations	10482	10482	10482	10512	10482
Adjusted R-squared	0.124	0.124	0.124	0.123	0.124

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00308*				
	(-1.86)				
Domestic credit * Maturity		-0.00388***			
		(-3.25)			
Capitalization * Maturity			-0.00175**		
			(-2.52)		
Bonds * Maturity				-0.00273	
				(-1.45)	
Total capitalization * Maturity					-0.00182***
					(-2.68)
Observations	10038	10038	10038	10065	10038
Adjusted R-squared	0.208	0.209	0.208	0.208	0.208

Table 7: Firm volatility, the use of long-term finance and firm age: old firms

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. The sample excludes financial firms and firms in the public sector, as well as sectors where the average age of US firms is below the median firm age. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity	-0.0407*				
	(-1.67)				
Domestic credit * Maturity		-0.0420***			
		(-2.65)			
Capitalization * Maturity			-0.00106		
			(-0.10)		
Bonds * Maturity				-0.0416	
				(-1.40)	
Total capitalization * Maturity					-0.000946
					(-0.09)
Observations	14127	14127	14127	14135	14127
Adjusted R-squared	0.132	0.132	0.132	0.132	0.132

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity	-0.00160				
	(-1.35)				
Domestic credit * Maturity		-0.00162**			
		(-2.12)			
Capitalization * Maturity			0.0000266		
			(0.05)		
Bonds * Maturity				-0.00649***	
				(-2.77)	
Total capitalization * Maturity					-0.0000523
					(-0.11)
Observations	12532	12532	12532	12539	12532
Adjusted R-squared	0.280	0.280	0.280	0.280	0.280

Table 8: Firm volatility, long-term finance, and accounting standards

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Accounting is an index of accounting standards in 1993, with higher values indicate more disclosure. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity * Accounting	0.00731*				
	(1.91)				
Private credit * Maturity	-0.575**				
	(-2.10)				
Domestic credit * Maturity * Accounting		0.00511			
		(1.19)			
Domestic credit * Maturity		-0.405			
		(-1.33)			
Capitalization * Maturity * Accounting			0.00551***		
			(2.97)		
Capitalization * Maturity			-0.411***		
			(-3.08)		
Bonds * Maturity * Accounting				0.0305**	
				(1.96)	
Bonds * Maturity				-2.307*	
				(-1.93)	
Total capitalization * Maturity * Accounting					0.00556***
					(3.08)
Total capitalization * Maturity					-0.414***
					(-3.20)
Maturity * Accounting	-0.00457	-0.00419	-0.00782**	-0.00384*	-0.00865***
	(-1.58)	(-1.08)	(-2.52)	(-1.74)	(-2.62)
Observations	20908	20908	20908	20908	20908
Adjusted R-squared	0.150	0.150	0.150	0.150	0.150

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity * Accounting	0.000306				
	(1.55)				
Private credit * Maturity	-0.0240*				
	(-1.67)				
Domestic credit * Maturity * Accounting		0.000217			
		(1.00)			
Domestic credit * Maturity		-0.0176			
		(-1.14)			
Capitalization * Maturity * Accounting			0.000109		
			(1.18)		
Capitalization * Maturity			-0.00849		
			(-1.25)		
Bonds * Maturity * Accounting				0.00171*	
				(1.90)	
Bonds * Maturity				-0.136**	
				(-1.96)	
Total capitalization * Maturity * Accounting					0.000114
					(1.22)
Total capitalization * Maturity					-0.00887
					(-1.31)
Maturity * Accounting	-0.000316*	-0.000296	-0.000266	-0.000283*	-0.000282
	(-1.75)	(-1.29)	(-1.50)	(-1.94)	(-1.47)
Observations	18950	18950	18950	18950	18950
Adjusted R-squared	0.294	0.295	0.294	0.294	0.294

Table 9: Firm volatility, long-term finance, and ease of getting credit

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Getting credit is an index of the legal rights of borrowers and lenders that facilitate lending and a better availability of credit information in 2006, with higher values indicating easier access to credit. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity * Getting credit	0.00117				
	(0.84)				
Private credit * Maturity	-0.129				
	(-1.27)				
Domestic credit * Maturity * Getting credit		0.00159			
		(0.95)			
Domestic credit * Maturity		-0.159			
		(-1.32)			
Capitalization * Maturity * Getting credit			0.00196***		
			(2.75)		
Capitalization * Maturity			-0.166***		
			(-2.99)		
Bonds * Maturity * Getting credit				0.0184***	
				(2.95)	
Bonds * Maturity				-1.405***	
				(-3.08)	
Total capitalization * Maturity * Getting credit					0.00194***
					(2.90)
Total capitalization * Maturity					-0.166***
					(-3.18)
Maturity * Getting credit	-0.00123	-0.00170	-0.00279**	-0.00175***	-0.00282**
	(-0.93)	(-1.07)	(-2.33)	(-2.60)	(-2.34)
Observations	24718	24718	24718	24718	24718
Adjusted R-squared	0.141	0.141	0.141	0.141	0.141
Panel B	(1)	(2)	(3)	(4)	(5)

	Asset volatility (stock)				
Private credit * Maturity * Getting credit	0.000276***				
	(4.04)				
Private credit * Maturity	-0.0206***				
	(-4.08)				
Domestic credit * Maturity * Getting credit		0.000267***			
		(3.38)			
Domestic credit * Maturity		-0.0216***			
		(-3.75)			
Capitalization * Maturity * Getting credit			0.000171***		
			(5.14)		
Capitalization * Maturity			-0.0134***		
			(-4.97)		
Bonds * Maturity * Getting credit				0.000834***	
				(3.31)	
Bonds * Maturity				-0.0681***	
				(-3.71)	
Total capitalization * Maturity * Getting credit					0.000161***
					(5.24)
Total capitalization * Maturity					-0.0126***
					(-5.08)
Maturity * Getting credit	-0.000290***	-0.000286***	-0.000282***	-0.000104***	-0.000276***
	(-4.50)	(-3.72)	(-5.50)	(-3.59)	(-5.48)
Observations	22683	22683	22683	22683	22683
Adjusted R-squared	0.271	0.271	0.271	0.270	0.271

Table 10: Firm volatility, long-term finance, and contract enforcement

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Contract enforcement is an index measuring the time and cost for resolving a commercial dispute through a local first-instance court in 2006, with higher values reflecting better enforcement. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity * Contract enforcement	-0.0000486				
	(-0.02)				
Private credit * Maturity	-0.0558				
	(-0.37)				
Domestic credit * Maturity * Contract enforcement		-0.00317			
		(-1.37)			
Domestic credit * Maturity		0.172			
		(1.07)			
Capitalization * Maturity * Contract enforcement			0.000477		
			(0.52)		
Capitalization * Maturity			-0.0529		
			(-0.78)		
Bonds * Maturity * Contract enforcement				0.00807	
				(0.67)	
Bonds * Maturity				-0.709	
				(-0.82)	
Total capitalization * Maturity * Contract enforcement					0.000519
					(0.59)
Total capitalization * Maturity					-0.0570
					(-0.87)
Maturity * Contract enforcement	0.000433	0.00222	-0.000525	-0.000745	-0.000534
	(0.31)	(1.27)	(-0.39)	(-0.74)	(-0.39)
Observations	24718	24718	24718	24718	24718
Adjusted R-squared	0.141	0.141	0.141	0.141	0.141
Panel B	(1)	(2)	(3)	(4)	(5)

	Asset volatility (stock)				
Private credit * Maturity * Contract enforcement	0.000498***				
	(5.07)				
Private credit * Maturity	-0.0383***				
	(-5.31)				
Domestic credit * Maturity * Contract enforcement		0.000458***			
		(4.14)			
Domestic credit * Maturity		-0.0351***			
		(-4.47)			
Capitalization * Maturity * Contract enforcement			0.000237***		
			(5.45)		
Capitalization * Maturity			-0.0183***		
			(-5.58)		
Bonds * Maturity * Contract enforcement				0.00183***	
				(2.87)	
Bonds * Maturity				-0.144***	
				(-3.09)	
Total capitalization * Maturity * Contract enforcement					0.000233***
					(5.49)
Total capitalization * Maturity					-0.0181***
					(-5.66)
Maturity * Contract enforcement	-0.000242***	-0.000304***	-0.000283***	-0.000106*	-0.000284***
	(-3.19)	(-3.18)	(-3.74)	(-1.80)	(-3.74)
Observations	22683	22683	22683	22683	22683
Adjusted R-squared	0.271	0.271	0.271	0.270	0.271

Table 11: Firm volatility, long-term finance, and insolvency resolution

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Resolving insolvency is an index measuring the time, cost and outcome of insolvency proceedings involving domestic entities as well as the strength of the legal framework applicable to liquidation and reorganization proceedings in 2006, with higher values indicating more efficient bankruptcy resolution. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity * Resolving insolvency	0.000276				
	(0.30)				
Private credit * Maturity	-0.0625				
	(-0.81)				
Domestic credit * Maturity * Resolving insolvency		0.000301			
		(0.41)			
Domestic credit * Maturity		-0.0690			
		(-1.01)			
Capitalization * Maturity * Resolving insolvency			0.0000883		
			(0.25)		
Capitalization * Maturity			-0.0159		
			(-0.57)		
Bonds * Maturity * Resolving insolvency				0.00891	
				(1.60)	
Bonds * Maturity				-0.782	
				(-1.64)	
Total capitalization * Maturity * Resolving insolvency					0.000117
					(0.32)
Total capitalization * Maturity					-0.0187
					(-0.66)
Maturity * Resolving insolvency	-0.000549	-0.000504	-0.000653	-0.00120**	-0.000673
	(-0.78)	(-0.78)	(-0.95)	(-2.32)	(-0.92)
Observations	24718	24718	24718	24718	24718
Adjusted R-squared	0.141	0.141	0.141	0.141	0.141

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity * Resolving insolvency	0.0000520				
	(1.11)				
Private credit * Maturity	-0.00436				
	(-1.14)				
Domestic credit * Maturity * Resolving insolvency		0.0000239			
		(0.67)			
Domestic credit * Maturity		-0.00399			
		(-1.21)			
Capitalization * Maturity * Resolving insolvency			0.0000374*		
			(1.94)		
Capitalization * Maturity			-0.00262*		
			(-1.83)		
Bonds * Maturity * Resolving insolvency				0.000308	
				(1.23)	
Bonds * Maturity				-0.0306	
				(-1.41)	
Total capitalization * Maturity * Resolving insolvency					0.0000387**
					(2.00)
Total capitalization * Maturity					-0.00273*
					(-1.90)
Maturity * Resolving insolvency	-0.000106***	-0.0000704**	-0.000131***	-0.0000808***	-0.000136***
	(-2.69)	(-2.03)	(-3.53)	(-3.14)	(-3.47)
Observations	22683	22683	22683	22683	22683
Adjusted R-squared	0.270	0.270	0.270	0.270	0.270

Table 12: Firm volatility, long-term finance, and government effectiveness

In Panel A the dependent variable is Asset volatility (book) which is the standard deviation of the growth rate of the book value of total assets over the period 1995-2013. In Panel B the dependent variable is Asset volatility (stock) which is the volatility of the value of a firm's assets calculated based on Merton's model averaged over the period 1995-2013. Maturity is the sectoral median of the average firm level ratio of long-term debt to total debt in the US over the period 1995-2013. Government effectiveness is an index capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures in 1996, with higher values indicating more effective government policies. Private credit is domestic credit to private sector by banks (% of GDP) as of year-end 1995. Domestic credit is domestic credit provided by financial sector (% of GDP) as of year-end 1995. Capitalization is the sum of Domestic credit and the market capitalization of listed companies (% of GDP) as of year-end 1995. Bonds is debt securities (% of GDP) as of year-end 1995. Total capitalization is the sum of Capitalization and Bonds. Sample includes all firms except financial firms and firms in the public sector. Country and industry fixed effects are included. Standard errors are clustered at the country-industry level. *, **, and *** denote significance at 10%, 5%, and 1%.

Panel A	(1)	(2)	(3)	(4)	(5)
	Asset volatility (book)				
Private credit * Maturity * Government effectiveness	-0.00438				
	(-0.11)				
Private credit * Maturity	-0.0319				
	(-0.73)				
Domestic credit * Maturity * Government effectiveness		-0.0609			
		(-1.34)			
Domestic credit * Maturity		0.0142			
		(0.33)			
Capitalization * Maturity * Government effectiveness			0.0256		
			(1.16)		
Capitalization * Maturity			-0.0298		
			(-1.33)		
Bonds * Maturity * Government effectiveness				0.169**	
				(2.15)	
Bonds * Maturity				-0.255**	
				(-2.41)	
Total capitalization * Maturity * Government effectiveness					0.0281
					(1.44)
Total capitalization * Maturity					-0.0315
					(-1.53)
Maturity * Government effectiveness	-0.0225	0.0247	-0.0629*	-0.0453***	-0.0694**
	(-0.74)	(0.64)	(-1.89)	(-2.87)	(-2.10)
Observations	24763	24763	24763	24801	24763
Adjusted R-squared	0.141	0.141	0.141	0.141	0.141

Panel B	(1)	(2)	(3)	(4)	(5)
	Asset volatility (stock)				
Private credit * Maturity * Government effectiveness	0.00381**				
	(2.10)				
Private credit * Maturity	-0.00417*				
	(-1.93)				
Domestic credit * Maturity * Government effectiveness		0.000542			
		(0.28)			
Domestic credit * Maturity		-0.00256			
		(-1.30)			
Capitalization * Maturity * Government effectiveness			0.00296***		
			(3.06)		
Capitalization * Maturity			-0.00263**		
			(-2.42)		
Bonds * Maturity * Government effectiveness				0.00310	
				(0.87)	
Bonds * Maturity				-0.00534	
				(-1.01)	
Total capitalization * Maturity * Government effectiveness					0.00260***
					(2.99)
Total capitalization * Maturity					-0.00225**
					(-2.21)
Maturity * Government effectiveness	-0.00558***	-0.00299*	-0.00699***	-0.00311***	-0.00685***
	(-3.84)	(-1.69)	(-4.80)	(-4.35)	(-4.76)
Observations	22713	22713	22713	22747	22713
Adjusted R-squared	0.271	0.271	0.271	0.270	0.271